

Patent Claims

1. A method for the automated application of a self-adhesive paint film to a bodywork part secured in a defined position using a freely programmable industrial robot provided with an application tool, which paint film is held ready in the form of a multi-layered film composite in a defined position in the working region of the industrial robot for picking up into the application tool by means of suction grippers, in which method a protective strip, which is on the adhesive side and is provided with a contact piece attached on the end side, is grasped at the contact piece, is removed from the film section, which is held taut, and its adhesive side is thus exposed, in which method, furthermore, the paint film section, which is held taut, is aligned in a precise position above the bodywork part to be covered, at a small distance from it, and, from the visible side of the paint film, with the paint film held in a fixed position over the bodywork part to be covered, is pressed progressively onto the bodywork part from the spaced-apart, taut position owing to a line of application moving over said paint film,

characterized by the mutuality of the following features:

- the rectangular film composite (10, 20) which protrudes on all sides over the bodywork portion (3) to be covered is secured on all four sides in the application tool (33),
- the protective strip (11, 23) on the adhesive side is removed from the paint film (12, 22) in a stationary and complete manner, and
- as the paint film (12, 22) continues to be pressed on, it is kept under tensile stress at least transversely to the direction in which the pressing-on operation continues.

2. The method as claimed in claim 1, characterized in that the tensile stress directed transversely to the direction in which the pressing-operation continues is exerted in the paint film (12, 22) by the taut plane of the paint film (12, 21) progressively approaching the bodywork part (3) to be covered, the latter (3) entering ever deeper into the taut plane (41) and care being taken here to ensure that, at the advancing point of effect of the line of application (52, 56) between the taut paint film (12, 21) and the surface of the bodywork part (3), a wedge-type gap opening in the direction in which the line of application (52, 56) continues is maintained.

3. The method as claimed in claim 2, characterized in that, as the paint film (12, 21) continues to be pressed on, the tensile stress in the taut part of the same or of the film composite (23, 21) is limited by the edge of the paint film (12) or of the film composite (23, 21) being secured with a limited force, so that the paint film (12) or the film composite (23, 21) can slide out of the edge clamping means.

4. The method as claimed in claim 1, characterized in that, as the paint film (12, 21) continues to be pressed on, in addition to the transversely directed tensile stress a width spreading effect is also exerted on the paint film (12, 21) by a press-on doctor (55) or press-on roller (45) producing the continuing line of application (52, 56).

5. The method as claimed in claim 4, characterized in that the width spreading effect is exerted owing to an approximately symmetrically curved profile of the advancing line of application (52, 56), with the center of the line of application (52, 56) running ahead of its ends.

6. The method as claimed in claim 1, characterized in that use is made of a three-layered film composite (20) in which the paint film (21), which is covered on the adhesive side by a protective strip, is contained in the form of a prefabricated paint film section and the latter is covered on its non-adhesive visible side by a self-adhesive protective strip (23) of rectangular section protruding over the paint film section (21) on all sides, the paint film section (21) being handled by the application tool (33) indirectly, i.e. with the rectangular protective strip (23) fitted in between, and in that, after the paint film section (21) has been completely pressed on, the rectangular protective strip (23) is removed owing to a suitable movement of the application tool (33) from the paint film (21) applied to the bodywork part (3) and is subsequently discarded via a waste collection container.

7. The method as claimed in claim 1, characterized in that use is made just of two layers, namely the paint film (12) which is unprotected on the visible side and a film composite (10) which contains a protective strip (11) adhering to the paint film on the adhesive side and which is designed overall as a rectangular section protruding on all sides over the bodywork portion (3) to be covered, the paint film (12), after the protective strip (11) has been removed from it, being handled directly and solely by the application tool (33) and being applied to the bodywork part (3), and in that the paint film (12) is only subsequently cut into shape.

8. The method as claimed in claim 7, characterized in that the paint film (12) is cut into shape, with the paint film (12) still being held in the application tool, by means of moveable cutters which are guided along templates (76, 76', 77, 77') integrated in the tool.

9. The method as claimed in claim 1, characterized in that, during the stationary removal of the protective strip (13, 24) on the adhesive side, a narrow radius of curvature (r) is forced, at

least initially, in the protective strip (13, 24) by a moveable counterpressure blade (67) having a transverse edge (68) rounded (r) in a defined manner being held against the advancing removal point.

10. The method as claimed in claim 1, characterized in that, during the application of paint film (12, 21) to an elongate bodywork part (3) curved symmetrically in the longitudinal direction, the paint film (12, 21) approaches the bodywork part (3) in the region of the centrally situated line of symmetry and is pressed on from there by means of two simultaneously effective lines of application (52, 56) advancing toward the ends of the bodywork part (3).

11. The method as claimed in claim 10, characterized in that the paint film (12, 21), which is held taut, is inclined, as it is being pressed on to the bodywork part (3) to be covered, at the point of the line of application (52, 56) in accordance with the inclination of the surface of the bodywork part (3), i.e. is aligned tangentially thereto and is correspondingly guided in inclination.

12. A device for the automated application of self-adhesive paint film to a bodywork part secured in a defined position, which paint film is contained in a multi-layered film composite which, apart from the paint film itself, at least still has a protective strip on the adhesive side with a contact piece which protrudes on the end side and is connected to the protective strip, which device comprises the following structural components:

- an application tool which can be manipulated by a freely programmable industrial robot and with which the paint film or the film composite can be handled and the paint film can be applied to the bodywork part,
- furthermore a suction gripper which is contained in the application tool, forms a picking-up plane by means of its active suction surfaces and with which the paint film or the film composite can be picked up from a held-ready flat position into the application tool in a taut state and in this manner can be handled by it,
- furthermore with a device for grasping the contact piece on the end side and for removing the protective strip on the adhesive side from the paint film, which is held taut, in which case its adhesive side is exposed,
- furthermore with a press-on doctor or press-on roller which is contained in the application tool, is moveable in the longitudinal direction of the paint film and can be lowered from a rest position, in which it is moved away from the picking-up plane, into a working position situated in the region of the picking-up plane, in which case the paint

film, which is aligned in a precise position above the bodywork part to be covered, at a small distance from it, can be pressed progressively onto the bodywork part from the spaced-apart position at a predetermined force by means of the press-on doctor or press-on roller,

in particular for carrying out the method as claimed in claim 1,

characterized by the mutuality of the following features:

- the film composite (10, 20) containing the paint film (12, 21) is designed with regard to its outer contours as a rectangle which protrudes over the bodywork portion (3) to be covered on all sides, i.e. even on the longitudinal sides, to be precise protrudes by more than just by the width of a lateral fold,
- the suction gripper contained in the application tool (33) is designed as a rectangular suction frame (35) which corresponds to the size of the film composite and is capable of securing the film composite (10, 20) on all four sides,
- the device for grasping the contact piece (13, 25) on the end side of the film composite (10, 20) is provided in the form of a stationary gripper (pair of gripping rollers (3) for the positionally fixed securing of the contact piece (13, 25) with which the protective strip (11, 24) on the adhesive side can be removed from the paint film (12, 21), which is held taut in the application tool (33), owing to a relative movement of the application tool (33) in relation to the stationary gripper (pair of gripper rollers 73) and/or a pull on the grasped contact piece (13, 25).

13. The device as claimed in claim 12, characterized in that the press-on roller (45) or press-on doctor (55) is designed and/or arranged in such a manner that the advancing line of application (52, 56) which can be applied by them runs in an approximately symmetrically curved manner, with the center of the line of application (52, 56) running ahead of its ends.

14. The device as claimed in claim 12, characterized in that the press-on roller (45), which is provided with an elastic covering (50), is of cylindrical or slightly convex design and, when bearing against the bodywork part (3), is more sharply flattened (flattening zone 51) under the press-on force in the center than at the ends of the roller.

15. The device as claimed in claim 12, characterized in that two separate press-on rollers (45) or press-on doctors (55) which are in each case displaceable in themselves in the longitudinal direction are arranged in a mirror-inverted manner with respect to each other in the application tool (33) and can be moved simultaneously from the longitudinal center of the application tool

(33), i.e. from the point of the first contact of the paint film (12, 21) on the bodywork part (3), toward the ends of the application tool (33).

16. The device as claimed in claim 12, characterized in that, in addition to the stationary gripper (pair of gripping rollers 73), a planar counterpressure blade (67) is provided, the plane of which is arranged at a small distance above the gripper (pair of gripping rollers 73) and which can be moved parallel to itself in the plane of the counterpressure blade (67) past the gripping opening of the gripper (pair of gripping rollers 73) with a presettable force in such a manner that it stretches the protective strip (11, 24) on the adhesive side in an L-shaped or U-shaped manner, which protective strip is grasped on the one hand by the stationary gripper (pair of gripping rollers 73) and on the other hand is held in the picking-up plane (41) of the application tool (33), and forces a narrow radius of curvature (r) on it as it loops around the transverse edge (68) of the counterpressure blade (67).

17. The device as claimed in claim 12, characterized in that for each frame limb of the suction frame (35) there is integrated in the application tool (33) a respective cutting template (76, 76', 77, 77') for cutting the applied paint film into shape, on which cutting templates cutters are guided moveably in a precise position.

18. The device as claimed in claim 12, characterized in that the frame limbs of the suction gripper (35) are divided into at least two suction chambers (36) which can in each case be separately subjected to a vacuum or can be ventilated, are directly adjacent to each other and extend in the longitudinal direction of a frame limb.

19. The device as claimed in claim 12, characterized in that a vacuum supplied to the suction chambers (36) of the suction gripper (35) is in each case provided with a bypass valve (38) for controlling the level of the vacuum.